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DATE MAILED: 12/18/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/782,626

Applicant(s)

HAKIM ET AL.

Examiner

Virginia M Kibler

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-87 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-87 is/are rejected.
- 7) ☒ Claim(s) 25,35-41, and 78-85 is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 13 February 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2,3.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). ____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Claim Objections

1. Claims 25, 35-41, and 78-85 are objected to because of the following informalities: “of is” should be changed to “are” in claim 25, line 3; “high sure / low sure” should be changed to “high-sure/low-sure” in claim 35, line 2 and in claim 78, line 4. Appropriate correction is required.

Claims 36-41 depend on claim 35, and are thereby objected to.

Claims 79-85 depend on claim 78, and are thereby objected to.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 1, 2, 24, 25, 44, 45, and 67 are rejected under 35 U.S.C. 102(b) as being anticipated by Hara et al. (4,692,690).

Regarding claims 1 and 44, Hara et al. (“Hara”) discloses inspecting electrical circuits including obtaining first image data relating to at least a part of an electrical circuit (Col. 8, lines 46-59), obtaining second image data generally corresponding to the part of an electrical circuit, where second image data includes at least some image data that its different from the first image data (Col. 8, lines 59-68, Col. 9, lines 1-30), modifying the first image data by employing the second image data thereby to produce an enhanced representation of the electrical circuit (Col. 9, lines 3-21), and inspecting the enhanced representation for defects (Col. 21-27).

Regarding claims 2 and 45, Hara discloses the first image data is in a first spectral range and the second image data includes at least some image data in a second spectral range (Col. 9, lines 28-35).

Regarding claims 24 and 67, Hara discloses the first and second images are acquired with at least one imager 11 comprising at least two different types of optical detectors 19, 15' arranged to view at least a portion of the electrical circuit illuminated by at least one illuminator (Figure 2).

Regarding claim 25, Hara discloses the first and second images are generally spatially coincidental and each of the first and second images are in a different spectral range (Col. 9, lines 28-35).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 3-23, 26, 27, 31, 32, 34-43, 46-66, 69, 70, 74, 75, and 77-87 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hara et al. (4,692,690) as applied to claims 1 and 44 above, and further in view of Caspi et al. (5,774,573).

Regarding claims 3, 6, 46, and 49, Hara does not appear to expressly recognize enhancing the contrast between at least some parts of the second image data representing corresponding parts of the electrical circuit. However, Caspi et al. ("Caspi") teaches that it is known to include

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enhancing contrast between at least some parts of the image data representing corresponding parts of the electrical circuit (Col. 3, lines 57-65; Col. 8, lines 7-30). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the images disclosed by Hara to include enhancing the contrast as taught by Caspi because it is well known methodology routinely implemented in the art for the detection of defects resulting in more accurate inspection.

Regarding claims 4, 7, 47, and 50, the arguments analogous to those presented above for claim 3 are applicable to claims 4, 7, 47, and 50. Caspi discloses the enhancing contrast is non-linear (Col. 9, lines 28-30).

Regarding claims 8, 9, 11, 12, 51, 52, 54, and 55, Hara does not appear to recognize convolving the first image with a function. However, Caspi teaches that it is known to convolve an image with an approximation of a two-dimensional second derivation (Laplacian) of a Gaussian function (Col. 8, lines 7-30; Col. 9, lines 28-30). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the images disclosed by Hara to include convolving the first image with an approximation of a Laplacian of a Gaussian function as taught by Caspi because it is well known methodology routinely implemented in the art for determining the location of the edges resulting in more accurate inspection.

Regarding claims 10, 13, 53, and 56, Hara and Caspi do not appear to specify that the modifying is carried out following the convolving. However, it would have been an obvious matter of design choice to specify the order of the modifying and convolving disclosed by Hara and Caspi.

Regarding claims 5 and 48, the arguments analogous to those presented above for claim 3 are applicable to claims 5 and 48. Caspi discloses enhancing contrast including redefining substrate portions not overlaying image data as opaque substrate portions, thus generally eliminating any distinction between substrate portions which overlay conductors and substrate portions which do not (Col. 9, lines 55-67, Col. 10, lines 1-21).

Regarding claims 14, 19, 57, and 62, Hara does not recognize determining in the first image data approximate locations of transitions between image regions having distinguishable optical characteristics and modifying comprising removing undesired ones of the transitions. However, Caspi teaches that it is known to determine the approximate locations of transitions between image regions having distinguishable optical characteristics (Col. 2, lines 7-17; Col. 3, lines 17-33 and modifying comprising removing undesirable ones of the transitions including overriding at least part of the convolved data (Col. 9, lines 55-67, Col. 10, lines 1-21). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the modifying disclosed by Hara to include determining the locations of transitions and removing undesired ones as taught by Caspi because such transitions represent the edges of lines in order to facilitate in differentiating between the substrate and the conductors to improve the defect detection accuracy.

Regarding claims 15, 20, 58, and 63, the arguments analogous to those presented above for claim 3 are applicable to claims 15, 20, 58, and 63. Caspi discloses the enhanced representation is a binary representation of the electrical circuit (Abstract). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the images disclosed by Hara to include enhanced binary representation as taught by Caspi

because it provides a greater resolution than the gray scale image (Col. 2, lines 66-67, Col. 3, lines 1-16).

Regarding claims 16, 21, 59, and 64, the arguments analogous to those presented above for claim 3 are applicable to claims 16, 21, 59, and 64. Caspi disclose the enhanced representation is a representation of contours in the electrical circuit, which indicate approximate locations of transitions between regions in the circuit exhibiting distinguishable optical characteristics (Col. 16, lines 7-18). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the images disclosed by Hara to include enhanced contour representation as taught by Caspi because it is well known in the art and allows for increased differentiation between the substrate and the conductors.

Regarding claims 17, 22, 60, and 65, the arguments analogous to those presented above for claim 3 are applicable to claims 17, 22, 60, and 65. Caspi discloses the enhanced representation has a spatial resolution greater than the original spatial resolution (Col. 2, lines 66-67, Col. 3, lines 1-16). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the images disclosed by Hara to include the enhanced representation with a greater spatial resolution because the larger the final pixel size involved in acquiring data from an object permits objects to be scanned faster, and either reduces the amount of light required or permits the same amount of light to be used thus decreasing the effect on accuracy of noise due to statistical variations in the amount of light (Col. 3, lines 1-16).

Regarding claims 18, 22, 61, and 66, the arguments analogous to those presented above for claim 3 are applicable to claims 18, 22, 61, and 66. Caspi discloses the enhanced representation has a gray scale whose dynamic range is reduced as compared with the dynamic

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range of the original data (Col. 13, lines 6-59). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the images disclosed by Hara to include enhanced representation with a reduced dynamic range as taught by Caspi because it is well known in the art and allows for increased differentiation between the substrate and the conductors.

Regarding claims 26 and 69, the arguments analogous to those presented above for claims 1, 2, and 4 are applicable to claims 26 and 69.

Regarding claims 27 and 70, Caspi teaches that it is known to include a circuit board with conductors on both sides (Col. 1, lines 20-29). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the circuit board disclosed by Hara to include conductors on both side as taught by Caspi because it is well known in the art and is a matter of design choice. Note, Caspi discloses enhanced contrast representation includes information providing enhanced contrast between representations of first conductors and of the substrate (Col. 5, lines 33-38).

Regarding claims 31 and 74, the arguments analogous to those presented above for claims 1 and 4 are applicable to claims 31 and 74. Caspi discloses applying a high-sure/low-sure region classifier (Col. 18, lines 38-56). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the images disclosed by Hara to include supplying the non-linearly enhanced image to a high-sure/low-sure region classifier as taught by Caspi because it is a methodology routinely implemented in the art in order to classify the pixels thereby increasing the accuracy of the inspection.

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Regarding claims 32, 33, 75 and 76, Caspi discloses that it is known to include a printed circuit board with both sides of the substrate having conductive tracks (Col. 1, lines 20-29). Caspi further discloses that more complex circuit boards will contain regions where the contrast between the tracks and substrate differs (Col. 13, lines 6-22) and it is necessary to redefine certain regions as substrate portions (Col. 13, lines 23-59). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the enhanced representation disclosed by Hara and Caspi to include redefining image data as substrate portions overlaying conductors because it increases the accuracy of the inspection of double sided circuit boards.

Regarding claims 34 and 77, the arguments analogous to those presented above for claim 31 are applicable to claims 34 and 77. Caspi discloses the high-sure/low-sure classifier including a low-sure region that to a high degree of confidence represents only substrate, a high-sure region that to a high degree of confidence represents only conductor located on the top surface of the electrical circuit, and a third region which is neither high-sure nor low-sure (Col. 18, lines 14-63).

Regarding claims 35, 78, and 79, Hara does not appear to disclose employing the high-sure/low-sure image to selectively modify an interim image to produce an enhanced representation of the circuit. However, Caspi teaches that it is known to employ the high-sure/low-sure image to selectively modify an interim image to produce an enhanced representation of the circuit (Col. 18, lines 47-56). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the images disclosed by

Hara to include employing the high-sure/low-sure image as taught by Caspi because it allows for further distinction between the substrate and conductors thereby increasing accuracy.

Regarding claims 36-39, the arguments analogous to those presented above for claim 9, 14, 15, and 16 are applicable to claims 36-39, respectively.

Regarding claims 80-83, the arguments analogous to those presented above for claim 9, 14, 15, and 16 are applicable to claims 80-83, respectively.

Regarding claims 40 and 84, the arguments analogous to those presented above for claim 14 are applicable to claims 40 and 84. Note, Caspi detects transitions between substrate and conductors on a top surface (Figure 5), thereby excluding transitions between substrate and other conductors, as claimed.

Regarding claims 41 and 85, Hara discloses analyzing for defects in the electrical circuit (Col. 10, lines 14-20).

Regarding claims 42 and 43, the arguments analogous to those presented above for claims 24 and 25 are applicable to claims 42 and 43, respectively.

Regarding claims 86 and 87, the arguments analogous to those presented above for claims 24 and 25 are applicable to claims 86 and 87, respectively.

6. Claims 29, 30, 72 and 73 are rejected under 35 U.S.C. 103(a) as being unpatentable over Elyasaf et al. (6,175,645) in view of Caspi et al. (5,774,573).

Regarding claims 29 and 72, Elyasaf et al. ("Elyasaf") discloses inspecting electrical circuit formed on different surfaces of a non-opaque substrate including obtaining image data relating to at least part of an electrical circuit (Abstract). Elyasaf does not appear to recognize enhancing the image data. However, Caspi et al. ("Caspi") teaches that it is known to include

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enhancing contrast between at least some parts of the image data representing corresponding parts of the electrical circuit thereby decreasing artifacts (Col. 3, lines 57-65; Col. 8, lines 7-30). Caspi further discloses that more complex circuit boards will contain regions where the contrast between the tracks and substrate differs (Col. 13, lines 6-22) and it is necessary to redefine certain regions as substrate portions (Col. 13, lines 23-59). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the images disclosed by Elyasaf to include enhancing the contrast as taught by Caspi because it is well known methodology routinely implemented in the art for the detection of defects resulting in more accurate inspection.

Regarding claims 30 and 73, Elyasaf does not appear to disclose conductors on both sides of the substrate. However, Caspi teaches that it is known to include a circuit board with conductors on both sides (Col. 1, lines 20-29). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the circuit board disclosed by Elyasaf to include conductors on both side as taught by Caspi because it is well known in the art and is a matter of design choice. Note, Caspi discloses the artifacts include at least part of an image from a substrate not having deposited thereon on conductors (Col. 13, lines 6-22).

7. Claims 28, 33, 71, and 76 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hara et al. (4,692,690) in view of Caspi et al. (5,774,573) as applied to claims 26, 31, 69, and 74 above, and further in view of Elyasaf et al. (6,175,645).

Regarding claims 28 and 71, Caspi discloses it is known to include enhancing contrast between at least some parts of the image data representing corresponding parts of the electrical circuit thereby decreasing artifacts (Col. 3, lines 57-65; Col. 8, lines 7-30). Caspi further

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discloses that more complex circuit boards will contain regions where the contrast between the tracks and substrate differs (Col. 13, lines 6-22) and it is necessary to redefine certain regions as substrate portions (Col. 13, lines 23-59). Hara and Caspi do not appear to recognize a non-opaque substrate. However, Elyasaf et al. ("Elyasaf") teaches inspecting electrical circuit formed on different surfaces of a non-opaque substrate including obtaining image data relating to at least part of an electrical circuit (Abstract). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the enhanced contrast representation disclosed by Hara and Caspi to include non-opaque characteristics as taught by Elyasaf because it is well known and allows for a more accurate inspection.

Regarding claims 33 and 76, the arguments analogous to those presented above for claims 32 and 28 are applicable to claims 33 and 76.

8. Claim 68 rejected under 35 U.S.C. 103(a) as being unpatentable over Hara et al. (4,692,690) as applied to claim 67 above, and further in view of Bishop et al. (5,524,152).

Regarding claim 68, Hara does not recognize including three types of detectors. However, Bishop et al. ("Bishop") teaches that it is known to include three detectors (Figure 4A), each of which is operative to output a generally spatially coincidental image (Col. 6, lines 62-67, Col. 7, lines 1-2). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the detectors disclosed by Hara to include three detectors as taught by Bishop because it is well known and routinely implemented in the art in order to extend to multicolor systems.

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Contact Information

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Virginia M Kibler whose telephone number is (703) 306-4072. The examiner can normally be reached on Mon-Thurs 8:00 - 5:30 and every other Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amelia Au can be reached on (703) 308-6604. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 306-0377.



VK

12/14/03

**MEHRDAD DASTOURI
PRIMARY EXAMINER**

